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BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte MARCOS KARNEZOS

Appeal 2016-001733
Application 11/337,168
Technology Center 2800

Before ADRIENE LEPIANE HANLON, JEFFREY T. SMITH, and MICHAEL G. McMANUS, *Administrative Patent Judges*.

McMANUS, *Administrative Patent Judge.*

DECISION ON APPEAL

The Examiner finally rejected claims 2 and 9–12 of Application 11/337,168 ("the '168 Application") under 35 U.S.C. § 112, ¶ 2 as indefinite. Final Act. 2–3 (Apr. 1, 2014). The Examiner also rejected claims 2 and 9–12 under 35 U.S.C. § 103(a) as obvious.[1] Final Act. 5–7.

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[1] The Examiner finally rejected claims 2, 9, 10 and 12 under 35 U.S.C. § 102(b) as anticipated. Final Act. 3–5. These rejections, however, were subsequently withdrawn by the Examiner. Answer 16.

Appellant[2] seeks reversal of these rejections pursuant to 35 U.S.C. § 134(a). We have jurisdiction under 35 U.S.C. § 6.

For the reasons set forth below, we AFFIRM.

BACKGROUND

The '168 Application relates to a semiconductor multi-package module which has stacked lower and upper packages and a heat spreader situated between the packages and a method of making such modules. Spec. 7–8, and 10.

Claim 2 is representative of the '168 Application's claims and is reproduced below from the Claims Appendix to the Appeal Brief:

> 1. A method for making a multi-package module, comprising:
>
> providing a first package including a first package substrate having at least two metal layers, each patterned on opposing surfaces of the first package substrate and connected by vias;
>
> mounting a heat spreader over the first package and coupled to the first package substrate;
>
> providing a second package including forming an upper package top surface by a molding compound for encapsulating a die attached to a second package substrate by wire bonds;
>
> inverting the second package and stacking the second package over the heat spreader and the first package including positioning the upper package top surface and
>
> the heat spreader between the second package substrate and the first package; and

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[2] General Motors LLC is identified as the real party in interest. Appeal Br. 4.

> electrically interconnecting the first package and the second package by z-interconnect wire bonds connecting the first package substrate and the second package substrate.

Appeal Br. 27 (Claims App.).

REJECTION

On appeal, the Examiner maintains the following rejections:

1. Claims 2 and 9–12 are rejected under 35 U.S.C. § 112, ¶ 2 for failure to particularly point out and distinctly claim the subject matter the applicant regards as the invention. Final Act. 2.

2. Claims 2, 9, 10 and 12 are rejected under 35 U.S.C. § 103(a) as unpatentable over Ishikawa (JP 2000-294723, pub. Oct. 20, 2000) (hereinafter "Ishikawa"). *Id.* at 5–6.

3. Claims 2 and 9–12 are rejected under 35 U.S.C. § 103(a) as unpatentable over the combination of Ishikawa and Hoffman et al. (US 6,737,750 B1, iss. May 18, 2004) (hereinafter "Hoffman"). *Id.* at 6–7.

DISCUSSION

Rejection 1.

The Examiner rejected claims 2 and 9–12 as indefinite on the basis that the scope of the term "z-interconnect wire bonds" is unclear. Final Act. 2.

Appellant argues that the Examiner has failed to state a prima facie case of indefiniteness and that one of ordinary skill in the art would understand the scope of such term when viewed in light of the Specification. Appeal Br. 11. Appellant further asserts that "claim 2 clearly informs the reader that the z-interconnect wire bonds connect the first package substrate and the second package substrate." *Id.* at 12.

The Specification teaches that there is a recent industry trend toward "integration on the 'z-axis,' that is, by stacking chips." Spec. 1. The Specification further provides that, "[a]ccording to the invention, z-interconnection between the stacked packages in the MPM [multi-package module] is wire bond based." *Id.* at 7–8. Additionally, the Specification teaches that "[t]he wire bond z-interconnect is well established in the industry . . . and it is directly applicable, without significant modification, to the stacked multipackage modules of the invention." *Id.* at 8. Moreover, the Specification teaches that fine pitch wire bonding "provides for more **interconnects between packages (z-interconnects)** in the same available space." *Id.* (emphasis added).

In regard to practicing the method of the present application, the Specification provides that "according to the invention for making multi-package modules the electrical connections between the stacked packages employ[ ] conventional wire bonding to form the z-interconnect between the inverted top package substrate and a bottom package substrate in the stack." *Id.* at 14.

Taken as a whole, and in conjunction with Figures 5A and 6A, it is apparent that the "z-axis" refers to the vertical direction in the context of stacked semiconductor packages. Further, the term "z-interconnect" refers to the electrical connection between the packages stacked one atop the other. Accordingly, the term "z-interconnect wire bonds" is construed to mean wire bonds that electrically connect two separate semiconductor packages arranged such that an upper package is stacked on top of a lower package.

During prosecution, a claim is examined for compliance with 35 U.S.C. § 112, ¶ 2 by determining whether the claim meets threshold requirements of clarity and precision. *In re Skvorecz*, 580 F.3d 1262, 1268

(Fed. Cir. 2009) (quoting MPEP § 2173.02). Here, the meaning of the term "z-interconnect wire bonds," considered in view of the Specification, would be apparent to one of ordinary skill in the art and, thus, the claim is sufficiently clear and precise.

Rejections 2 and 3.

The Examiner rejected claims 2, 9, 10, and 12 as obvious over Ishikawa (Rejection 2), Final Act. 5–6, and claims 2 and 9–12 as obvious over Ishikawa in view of Hoffman (Rejection 3), *id.* at 6–7.

Appellant argues that the claims are not obvious over Ishikawa (Rejection 2) because Ishikawa does not "teach or suggest the limitation of positioning the upper package top surface and the heat spreader between the second package substrate and the first package." Appeal Br. 18. Rather, Appellant asserts, Ishikawa teaches to mount a metallic plate 18 (heat spreader) so that it is exposed above the upper semiconductor carrier. *Id.* at 18–19; *see* Ishikawa Fig. 1. The Board finds such argument persuasive and reverses Rejection 2.

In Rejection 3 the Examiner relies upon Ishikawa as the primary reference and Hoffman as a secondary reference. The Examiner finds that Hoffman teaches to position a second package surface and the heat spreader between the second (upper) package substrate and the first (lower) package. Final Act. 6; *see also* Hoffman 9:61–11:4, Fig. 12A. The Examiner finds that a person of ordinary skill in the art would be motivated to position a heat spreader between the first and second die, as taught by Hoffman, when making a multi-package module as taught by Ishikawa, so as improve heat dissipation. Final Act. 7.

Appellant argues that the combination of Ishikawa and Hoffman would not teach the claimed method because Hoffman discloses a multi-chip

package while Ishikawa relates to a multi-chip module. *Id.* at 21. Similarly, Appellant contends that "the combination of Ishikawa and Hoffman would only result in the multi-chip package of Hoffman residing within the multi-package module of Ishikawa, without disclosing the claimed invention." *Id.* at 23–24. As a consequence, the combination would not teach "the claimed limitation of positioning the upper package top surface and the heat spreader between the second package substrate and the first package." *Id.* at 23 (underscoring in original).

"Claims may be obvious in view of a combination of references, even if the features of one reference cannot be substituted physically into the structure of the other reference." *Orthopedic Equip. Co. v. United States*, 702 F.2d 1005, 1013 (Fed. Cir. 1983); *In re Keller*, 642 F.2d 413, 425 (CCPA 1981) ("The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference."). Here, Hoffman discloses the use of a metal layer[3] positioned between a first die (integrated circuit) 12 and a second die 16 stacked above it so as to act as a heat spreader 33. Hoffman 9:64–10:7, Fig. 12A. Hoffman further teaches that "[t]he heat spreader transfers heat from the first and second dies to a heat sink of the substrate" and that "[t]he support structure and the heat spreader mitigate the transfer of heat between the first and second dies." *Id.* Abst. Thus, Appellant's argument regarding Ishikawa not teaching a heat spreader between the stacked packages is remedied by the teachings of Hoffman. Appellant's argument that Hoffman teaches a multi-chip package rather than a multi-chip module is unavailing.

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[3] Both Hoffman and the Specification teach that the heat spreader may be of copper or other metals. *Compare* Hoffman 9:66–10:2 *to* Spec. 24.

A heat spreader positioned intermediate two stacked dies was known in the art and would have been expected to perform its known function, i.e., the dissipation of heat, when positioned between two packages in Ishikawa. "The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007).

In sum, the Examiner finds Ishikawa teaches to make a multi-package module, Appeal Br. 21, with stacked packages in an inverted formation, z-interconnect wire bonds 13, and a metal heat spreader 18, while Hoffman teaches to position a heat spreader intermediate the two packages so as to dissipate heat generated by the dies. The Examiner further finds that one of ordinary skill in the art would have known that the heat spreader of Ishikawa could be positioned intermediate the two packages and thereby dissipate heat from the dies. Appellant has failed to show reversible error in the Examiner's findings.

CONCLUSION

For the reasons set forth above, we reverse the rejection of claims 2 and 9–12 on the basis of indefiniteness, reverse the rejection of claims 2, 9, 10, and 12 on the basis of obviousness over Ishikawa alone, and affirm the rejection of claims 2 and 9–12 on the basis of obviousness over Ishikawa in view of Hoffman.

AFFIRMED